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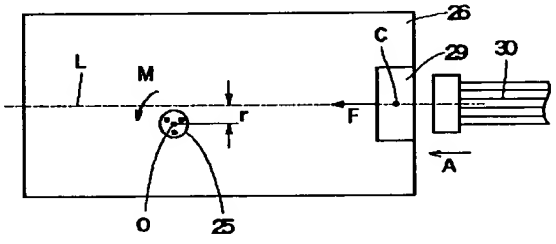
(54)【発明の名称】　射出光学装置

(57)【要約】

【目的】　電気回路基板に圧力を加えることなく、コネクタとケーブルを接続して装置の回転を防止する。

【構成】　電気回路基板２６上のコネクタ２９の中心Ｃを通り矢印Ａと平行な仮想線Ｌを設け、仮想線Ｌと電気回路基板２６における半導体レーザー光源２５の取付中心Ｏとの距離ｒと、ハーネス３０を着脱する際のコネクタ２９に加わる力Ｆとの積が、所定値以下となるように電気回路基板２６上のコネクタ２９の位置を決定し、このコネクタ２９に対し矢印Ａで示す水平方向にハーネス３０を接続する。



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【特許請求の範囲】

【請求項1】　半導体レーザー光源と、該半導体レーザー光源から出射されたレーザー光を平行光にするコリメータレンズと、前記半導体レーザー光源を駆動する電気回路基板と、前記半導体レーザー光源を保持する支持部材とを有し、前記電気回路基板上に前記半導体レーザー光源を駆動する電源及び電気信号を伝達するケーブルを接続するためのコネクタを設け、該コネクタと前記ケーブルの取付方向を前記電気回路基板に対して水平方向とし、該取付方向と平行でかつ前記コネクタの中心を通る仮想線から、前記電気回路基板上における前記半導体レーザー光源の取付中心位置までの距離と前記コネクタの取り付け／取り外しに加わる力との積が所定の値以下となるように前記コネクタの位置を設定したことを特徴とする射出光学装置。

【請求項2】　前記コネクタの中心を通る仮想線から前記半導体レーザー光源の取付中心位置までの距離をｒ（ｃｍ）、前記コネクタの取り付け／取り外しに加わる力をＦ（ｋｇ）とすると、Ｆ・ｒ≦３（ｋｇｆ・ｃｍ）なる関係を有する請求項１に記載の射出光学装置。

【請求項3】　前記半導体レーザー光源は複数の光ビームを出射するマルチビームレーザー光源とした請求項１に記載の射出光学装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、レーザービームコリメータユニットや、半導体レーザー光源を用いた光ディスクのピックアップユニットなどに供する射出光学装置に関するものである。

【０００２】

【従来の技術】従来から、画像信号により変調されたレーザービームを記録媒体上に走査して、画像を記録するレーザービームプリンタなどの記録装置が一般に知られている。

【０００３】図５は従来の射出光学装置の斜視図を示し、半導体レーザー光源１の前方の光路上には、コリメータレンズ２、ポリゴンミラーなどの偏向器３が配列され、偏向器３の反射方向の光路上には、結像レンズ光学系４、記録媒体である感光ドラム５が配列されている。

【０００４】画像信号により変調された半導体レーザー光源１からのレーザービームは、コリメータレンズ２により平行光とされ、偏向器３により偏向されて、結像レンズ光学系４によって記録媒体５上に結像走査される。このようにして、レーザービームプリンタなどのレーザーユニットに使用する場合には、半導体レーザー光源１からの出射光は発光点から放射状に拡がる性質を有するために、コリメータレンズ２を用いて平行光束とするのが一般的である。

【０００５】図６はレーザーユニットの断面図を示し、図７は図６のＺ方向から見た背面図である。基台１０の

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背面には電気回路基板１１が取り付けられ、基台１０の前面にはホルダ１２がばね付きねじ１３ａ、１３ｂにより固定されている。横断面が略凸状に形成されたホルダ１２は基台１０の調整治具の基準部分に固定されており、ホルダ１２の中空内部にはコリメータレンズ２を設けた鏡筒１４が嵌合され、ホルダ１２の中空内部の略中心付近の基台１０上には半導体レーザー光源１が固定されている。また、電気回路基板１１には各種の電子部品と共にコネクタ１５が固定され、コネクタ１５には信号ケーブル１６が接続されている。

【０００６】このような射出光学装置において、固定されたホルダ１２に対して基台１０をＸ－Ｙ方向に微小量移動させ、コリメータレンズ２の光軸と半導体レーザー光源１の光軸とが一致するように基台１０の光軸調整を行う。

【０００７】先ず、調整前にばね付きねじ１３ａ、１３ｂを緩めた半固定状態で、基台１０とホルダ１２を固定し、この状態で所定の範囲内に調整を行った後に、ばね付きねじ１３ａ、１３ｂを増し締めし強固に固定する。次に、鏡筒１４を光軸方向のＺ方向に微小量移動して所定の範囲内に調整が完了した後に、鏡筒１４とホルダ１２を接着固定して光学調整を完了する。光学調整が完成した射出光学装置に電気回路基板１１が取り付けた後に、光学部材を収納する図示しない光学箱に取り付け、更に光学箱は図示しない記録装置本体に取り付けられ、電気回路基板１１上のコネクタ１５に信号ケーブル１６が接続される。

【０００８】

【発明が解決しようとする課題】しかしながら上述の従来例においては、コネクタ１５の接続方向が電気回路基板１１に垂直な場合には、接続の際に電気回路基板１１を曲げる方向に力が加わるために、電気回路基板１１自体及び電気回路基板１１上の電子素子が破損したり剥離したりすることがある。また、コネクタ１５の接続方向が電気回路基板１１に水平な場合には、コネクタ１５の位置によって射出光学装置に回転方向の力が加わるために、射出光学装置が回転することがあり、特に複数のビームの間隔を高精度に調整しているマルチビームレーザー光源を用いた場合には、これが致命的な欠陥となる。

【０００９】本発明の目的は、上述の問題点を解消し、電気回路基板に圧力を加えることなくコネクタとケーブルの接続を行い装置の回転を防止する射出光学装置を提供することにある。

【００１０】

【課題を解決するための手段】上記目的を達成するための本発明に係る射出光学装置は、半導体レーザー光源と、該半導体レーザー光源から出射されたレーザー光を平行光にするコリメータレンズと、前記半導体レーザー光源を駆動する電気回路基板と、前記半導体レーザー光源を保持する支持部材とを有し、前記電気回路基板上に

前記半導体レーザー光源を駆動する電源及び電気信号を伝達するケーブルを接続するためのコネクタを設け、該コネクタと前記ケーブルの取付方向を前記電気回路基板に対して水平方向とし、該取付方向と平行でかつ前記コネクタの中心を通る仮想線から、前記電気回路基板上における前記半導体レーザー光源の取付中心位置までの距離と前記コネクタの取り付け／取り外しに加わる力との積が所定の値以下となるように前記コネクタの位置を設定したことを特徴とする。

【００１１】

【発明の実施の形態】本発明を図１～図４に図示の実施例に基づいて詳細に説明する。図１は第１の実施例の射出光学装置の斜視図を示し、記録装置本体２０上には光学箱２１が取り付けられ、光学箱２１にはホルダ２２が固定されている。光学箱２１の内部において、ホルダ２２にはコリメータレンズ２３を内設する鏡筒２４と半導体レーザー光源２５が支持されており、鏡筒２４は光軸調整及びピント調整のためにＸＹＺ方向にそれぞれ移動可能とされている。

【００１２】また、光学箱２１の外側にはホルダ２２に半導体レーザー光源２５を駆動する電気回路基板２６が固定されており、射出光学装置が光学箱２１にねじ２７によって取り付けられ、電気回路基板２６はコントローラ２８とコネクタ２９、ハーネス３０を介して接続されている。

【００１３】図２は電気回路基板２６の正面図を示し、電気回路基板２６上のコネクタ２９に対しハーネス３０は、矢印Ａ方向の電気回路基板２６と水平方向に接続されている。ここで、コネクタ２９の中心Ｃを通り矢印Ａと平行な仮想線Ｌを設け、仮想線Ｌと電気回路基板２６における半導体レーザー光源２５の取付中心Ｏとの距離をｒ（ｃｍ）とし、コネクタ２９に加わるハーネス３０を着脱する力をＦ（ｋｇｆ）とすると、Ｆ・ｒ≦３（ｋｇｆ・ｃｍ）の関係となるようにコネクタ２９の位置を決定する。

【００１４】この関係式は実験的に得られたものであり、実験ではＦ＝２ｋｇｆ、ｒ＝３ｃｍのときホルダ２２の回転が生じたことが分かっているので、これからホルダ２２に加わるモーメントは６ｋｇｆ・ｃｍ以下となり、上記の式は安全率を２倍に見込んで３ｋｇｆ／ｃｍ以下としている。また、コネクタ２９の着脱に必要な力は最大で６ｋｇｆ程度であることが実験で得られているので、上記の式からｒ＝０．５ｃｍとなる。

【００１５】このような位置にコネクタ２９を配置して矢印Ａ方向にハーネス３０の接続を行えば、コネクタ２９にハーネス３０を着脱する際の電気回路基板２６に加わる力は矢印Ａと同じ方向になるので、電気回路基板２６を曲げるような力を加えることがなくなり、更に射出光学装置を回転させるモーメント力を小さく抑えることができ、射出光学装置が位置ずれを生ずるという問題を回避することができる。

【００１６】図３は第２の実施例の射出光学装置の斜視図、図４は半導体レーザー光源の正面図を示し、図１と同じ番号は同じ部材を表している。ホルダ２２には、複数の光源を有するマルチビーム半導体レーザー光源３１とコリメータレンズ２３及び電気回路基板２６が支持されており、電気回路基板２６にはコネクタ２９が固定されている。

【００１７】ビーム間距離の調整は、２個以上の複数の光源を有するマルチビーム半導体レーザー光源３１の全てについて同様に行うことができるので、ここでは２個の光源を有する半導体レーザー光源３１について説明する。先ず、半導体レーザー光源３１の２個の発光点３１ａ、３１ｂのＹ方向の初めの間隔をt1とし、次に半導体レーザー光源３１をホルダ２２により図４の矢印Ｂ方向に回転させると、発光点３１ａ、３１ｂのＹ方向の距離は小さくなり間隔t2となる。

【００１８】ここで、ホルダ２２と電気回路基板２６が固定されているために、電気回路基板２６を回転させる方向の力Ｆが加わると調整が狂ってしまう危険性がある。従って、コネクタ２９の中心を通る仮想線Ｌから近い方の発光点３１ａ又は３１ｂまでのＹ方向の距離ｒ’が、第１の実施例と同様にＦ・ｒ’≦３となるようにコネクタ２９の位置を設定すれば、ビーム間距離の調整を狂わせる危険性を回避することができる。

【００１９】

【発明の効果】以上説明したように本発明に係る射出光学装置は、コネクタとケーブルを接続する方向を電気回路基板に対して水平方向とし、取付方向と平行でかつコネクタの中心を通る仮想線から電気回路基板上における半導体レーザー光源の取付中心までの距離と、コネクタの取り付け／取り外しに加わる力との積を、所定の値以下となるようにコネクタの位置決めを行うことにより、電気回路基板に圧力を加えることなくコネクタとケーブルの接続を行うことができ、電気回路基板自体や電気回路基板上の電子素子の破損や剥離を防止し、更に射出光学装置の回転を回避することができる。

【図面の簡単な説明】

【図１】第１の実施例の射出光学装置の斜視図である。

【図２】電気回路基板の平面図である。

【図３】第２の実施例の射出光学装置の斜視図である。

【図４】マルチビーム半導体レーザー光源の正面図である。

【図５】従来例の射出光学装置の斜視図である。

【図６】レーザーユニットの断面図である。

【図７】背面図である。

【符号の説明】

２１　光学箱

２２　ホルダ

２３　コリメータレンズ

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24　鏡筒

25、31　半導体レーザー光源

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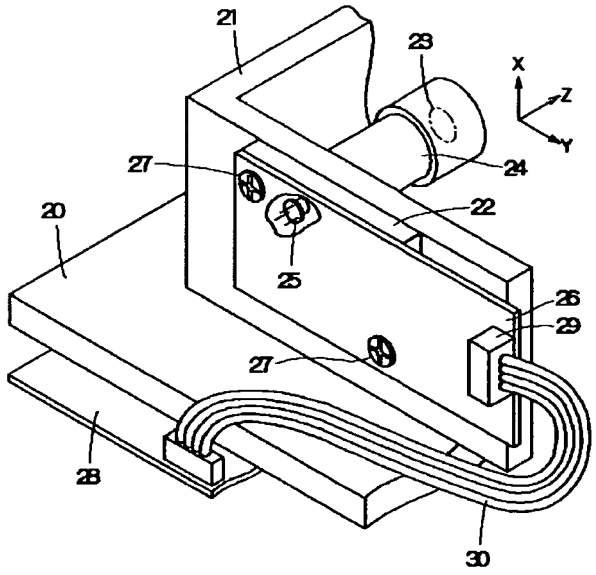
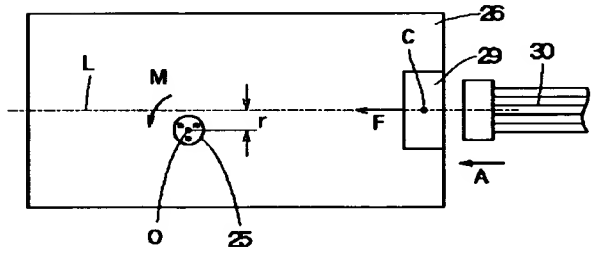
26　電気回路基板

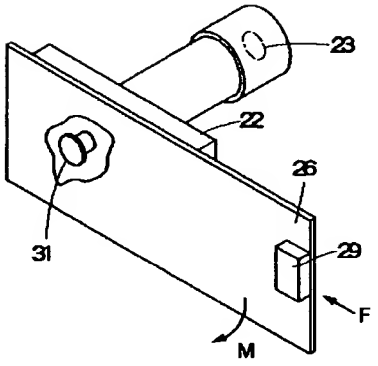
【図1】



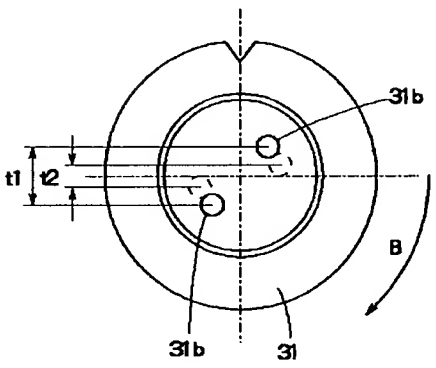
【図2】



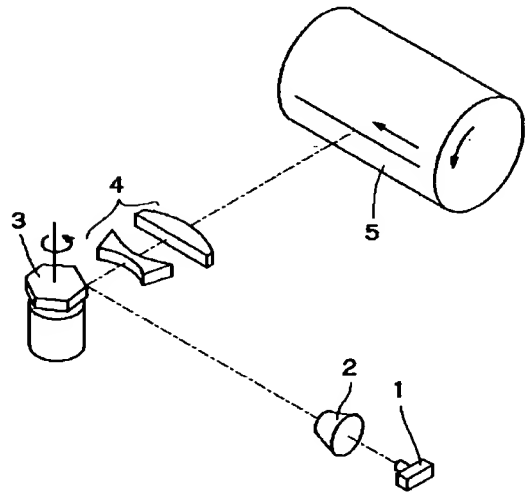
【図3】



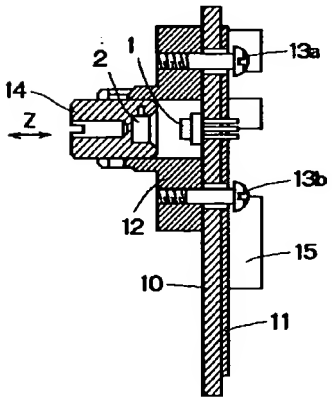
【図4】



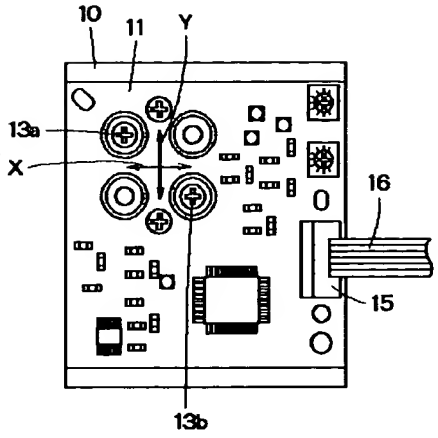
【図5】



【図6】



【図7】



PATENT ABSTRACTS OF JAPAN

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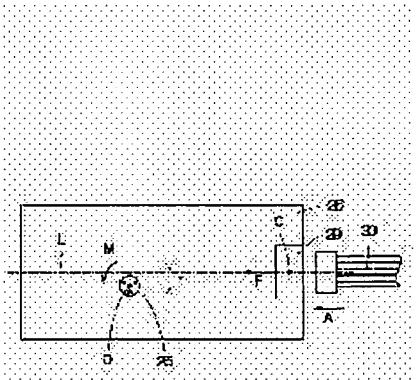
(71)Applicant : **CANON INC**
(72)Inventor : **TOMITA KENICHI**

(54) PROJECTION OPTICAL DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent a device from being rotated without adding pressure to an electrical circuit board by connecting a connector and a cable.
SOLUTION: A virtual line L being in parallel with an arrow A is formed through the center C of the connector 29 on the electrical circuit board 26. Besides, the position of the connector 29 on the substrate 26 is decided so that the product of a distance (r) between the line L and the fitting center of a semiconductor laser light source 25 on the substrate 26 and force F added to the connector 29 when a harness 30 is attached and detached becomes equal to or under a prescribed value. Then, the harness 30 is connected to the connector 29 in a horizontal direction shown by the arrow A.



LEGAL STATUS

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[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3397581
[Date of registration]	14.02.2003
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the injection optical equipment with which a laser beam collimator unit, the pickup unit of an optical disk which used the semiconductor laser light source are presented.
[0002]
[Description of the Prior Art] From the former, the laser beam modulated by the picture signal is scanned on a record medium, and, generally recording devices, such as a laser beam printer which records an image, are known.
[0003] Drawing 5 shows the perspective diagram of conventional injection optical equipment, the deflecting system 3, such as a collimator lens 2 and a polygon mirror, is arranged, and the image formation lens optical system 4 and the photoconductor drum 5 which is a record medium are arranged on the optical path of the reflective direction of deflecting system 3 at the optical-path top ahead of the semiconductor laser light source 1.
[0004] The laser beam from the semiconductor laser light source 1 modulated by the picture signal is made parallel light by the collimator lens 2, it is deflected by deflecting system 3 and an image formation scan is carried out by the image formation lens optical system 4 on a record medium 5. Thus, when using it for laser units, such as a laser beam printer, since it has the property which spreads in a radial from the point emitting light, it is common [the outgoing radiation light from the semiconductor laser light source 1] to use a collimator lens 2 and to consider as the parallel flux of light.
[0005] Drawing 6 shows the cross section of a laser unit, and drawing 7 is the rear view seen from the Z direction of drawing 6 . The electrical circuit substrate 11 is attached in the back of a pedestal 10, and the holder 12 is being fixed to the front face of a pedestal 10 with the screw threads 13a and 13b with a spring. The holder 12 with which the cross section was formed in the shape of a rough convex is being fixed to the criteria portion of the Seiji Shirabe implement of a pedestal 10, the lens-barrel 14 which formed the collimator lens 2 fits into the interior of the hollow of a holder 12, and the semiconductor laser light source 1 is being fixed on the pedestal 10 near the abbreviation center inside the hollow of a holder 12. Moreover, a connector 15 is fixed to the electrical circuit substrate 11 with various kinds of electronic parts, and the signal cable 16 is connected to the connector 15.
[0006] In such injection optical equipment, the minute amount migration of the pedestal 10 is made to carry out in the direction of X-Y to the fixed holder 12, and optical-axis adjustment of a pedestal 10 is performed so that the optical axis of a collimator lens 2 and the optical axis of the semiconductor laser light source 1 may be in agreement.
[0007] First, in the state of semipermanent [which loosened the screw threads 13a and 13b with a spring before adjustment], after fixing a pedestal 10 and a holder 12 and adjusting within the limits of predetermined with this condition, tightening of the screw threads 13a and 13b with a spring is carried out, and it fixes firmly. Next, after carrying out minute amount migration of the lens-barrel 14 at the Z direction of the direction of an optical axis and completing adjustment within the limits of predetermined, adhesion immobilization of a lens-barrel 14 and the holder 12 is carried out, and optical adjustment is completed. after the electrical circuit substrate 11 attaches in the injection optical equipment which optical adjustment completed, it is attached at the optical box which contains an optical member and which is not a drawing example on the main part of installation and the recording device which an optical box does not have a drawing example further, and a signal cable 16 is connected to the connector 15 on the electrical circuit substrate 11.
[0008]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional example, since the force is added in the direction which bends the electrical circuit substrate 11 in the case of connection when the connection direction of a connector 15 is perpendicular to the electrical circuit substrate 11, the electronic device on electrical circuit substrate 11 the very thing and the electrical circuit substrate 11 may damage or exfoliate. Moreover, when the connection direction of a connector 15 is level to the electrical circuit substrate 11, in order for the force of a hand of cut to join injection optical equipment with the location of a connector 15, when the multi-beam laser light source which injection optical equipment may rotate and is adjusting the gap of two or more beams to high degree of accuracy especially is used, this serves as a fatal defect.
[0009] The purpose of this invention is to offer the injection optical equipment which makes connection of a connector and a cable and prevents rotation of equipment, without canceling an above-mentioned trouble and applying a pressure to an electrical circuit substrate.
[0010]
[Means for Solving the Problem] Injection optical equipment concerning this invention for attaining the above-mentioned purpose The semiconductor laser light source and a collimator lens which makes parallel light laser light by which outgoing radiation was

carried out from this semiconductor laser light source, It has an electrical circuit substrate which drives said semiconductor laser light source, and supporter material holding said semiconductor laser light source. A connector for connecting a cable which transmits a power supply and an electrical signal which drive said semiconductor laser light source is prepared on said electrical circuit substrate. The attachment direction of this connector and said cable is made horizontal to said electrical circuit substrate. From an imaginary line which is parallel to this attachment direction, and passes along a center of said connector It is characterized by setting up a location of said connector so that a product of distance to an attachment center position of said semiconductor laser light source on said electrical circuit substrate and force of joining installation/removal of said connector may become below a predetermined value.

[0011]

[Embodiment of the Invention] This invention is explained to drawing 1 - drawing 4 at details based on the example of illustration. Drawing 1 shows the perspective diagram of the injection optical equipment of the 1st example, the optical box 21 is attached on the main part 20 of a recording device, and the holder 22 is being fixed to the optical box 21. In the interior of the optical box 21, the lens-barrel 24 and the semiconductor laser light source 25 which install a collimator lens 23 inside are supported by the holder 22, and the lens-barrel 24 is made respectively movable in the XYZ direction for optical-axis adjustment and focus adjustment.

[0012] Moreover, the electrical circuit substrate 26 which drives the semiconductor laser light source 25 is being fixed to the outside of the optical box 21 by the holder 22, injection optical equipment ****s in the optical box 21, and is attached by 27, and the electrical circuit substrate 26 is connected with the controller 28 through the connector 29 and the harness 30.

[0013] Drawing 2 shows the front view of the electrical circuit substrate 26, and the harness 30 is horizontally connected with the electrical circuit substrate 26 of the direction of arrow head A to the connector 29 on the electrical circuit substrate 26. Here, if the imaginary line L parallel to an arrow head A is formed through the center C of a connector 29, distance based on [of the semiconductor laser light source 25 in an imaginary line L and the electrical circuit substrate 26 / O] attachment is set to r (cm) and the force which detaches and attaches the harness 30 which joins a connector 29 is set to F (kgf), it will be determined that the location of a connector 29 will become the relation of F-r<=3 (kgf-cm).

[0014] Since it turns out that this relational expression was obtained experimentally and rotation of a holder 22 arose in the experiment at the time of F=2kgf and r= 3cm, the moment which will join a holder 22 from now on becomes 6 or less kgf-cm, and the above-mentioned formula expects a safety factor twice, and may be 3 or less kgf/cm. Moreover, since it is acquired in the experiment that the force required for attachment and detachment of a connector 29 is 6kgf degree at the maximum, it is set to r= 0.5cm from the above-mentioned formula.

[0015] If a connector 29 is arranged in such a location and a harness 30 is connected in the direction of arrow head A, since the force of joining the electrical circuit substrate 26 at the time of detaching and attaching a harness 30 to a connector 29 will become in the same direction as an arrow head A Applying the force in which the electrical circuit substrate 26 is bent can be lost, the moment force of rotating injection optical equipment further can be suppressed small, and the problem that injection optical equipment produces a location gap can be avoided.

[0016] Drawing 3 shows the perspective diagram of the injection optical equipment of the 2nd example, drawing 4 shows the front view of the semiconductor laser light source, and the same number as drawing 1 expresses the same member. The multi-beam semiconductor laser light source 31 and the collimator lens 23 which have two or more light sources, and the electrical circuit substrate 26 are supported by the holder 22, and the connector 29 is being fixed to the electrical circuit substrate 26.

[0017] Since adjustment of the distance between beams can be similarly performed about all the multi-beam semiconductor laser light sources 31 that have two or more two or more light sources, the semiconductor laser light source 31 which has the two light sources here is explained. First, if the first gap of the direction of Y of two points 31a and 31b of the semiconductor laser light source 31 emitting light is set to t1 and then the semiconductor laser light source 31 is rotated in the direction of arrow head B of drawing 4 with a holder 22, the distance of the direction of Y of the points 31a and 31b emitting light will become small, and will serve as a gap t2.

[0018] Here, since the holder 22 and the electrical circuit substrate 26 are being fixed, when the force F of a direction of rotating the electrical circuit substrate 26 is added, there is a danger that adjustment will be out of order. Therefore, if distance r' of the direction of Y from the imaginary line L passing through the center of a connector 29 to emitting light point 31a or 31b of the nearer one sets up the location of a connector 29 so that it may be set to F-r'<=3 like the 1st example, the danger of putting adjustment of the distance between beams out of order is avoidable.

[0019]

[Effect of the Invention] The injection optical equipment applied to this invention as explained above The distance from the imaginary line which the direction which connects a cable with a connector is made horizontal to an electrical circuit substrate, and is parallel to the attachment direction, and passes along the center of a connector to the attachment center of the semiconductor laser light source on an electrical circuit substrate, By positioning a connector so that it may become below a predetermined value about a product with the force of joining installation/removal of a connector Connection of a connector and a cable can be made without applying a pressure to an electrical circuit substrate, failure and exfoliation of the electronic device on the electrical circuit substrate itself and an electrical circuit substrate can be prevented, and rotation of injection optical equipment can be avoided further.

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram of the injection optical equipment of the 1st example.
[Drawing 2] It is the plan of an electrical circuit substrate.
[Drawing 3] It is the perspective diagram of the injection optical equipment of the 2nd example.
[Drawing 4] It is the front view of the multi-beam semiconductor laser light source.
[Drawing 5] It is the perspective diagram of the injection optical equipment of the conventional example.
[Drawing 6] It is the cross section of a laser unit.
[Drawing 7] It is rear view.
[Description of Notations]
21 Optical Box
22 Holder
23 Collimator Lens
24 Lens-barrel
25 31 Semiconductor laser light source
26 Electrical Circuit Substrate

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] Have the following and a connector for connecting a cable which transmits a power supply and an electrical signal which drive said semiconductor laser light source is prepared on said electrical circuit substrate. The attachment direction of this connector and said cable is made horizontal to said electrical circuit substrate. From an imaginary line which is parallel to this attachment direction, and passes along a center of said connector Injection optical equipment characterized by setting up a location of said connector so that a product of distance to an attachment center position of said semiconductor laser light source on said electrical circuit substrate and force of joining installation/removal of said connector may become below a predetermined value. The semiconductor laser light source A collimator lens which makes parallel light laser light by which outgoing radiation was carried out from this semiconductor laser light source An electrical circuit substrate which drives said semiconductor laser light source Supporter material holding said semiconductor laser light source
[Claim 2] if force of joining r (cm), and installation/removal of said connector in distance from an imaginary line passing through a center of said connector to an attachment center position of said semiconductor laser light source is set to F (kg) -- F-r<=3 (kgf-cm) -- injection optical equipment according to claim 1 which has relation.
[Claim 3] Said semiconductor laser light source is injection optical equipment according to claim 1 made into the multi-beam laser light source which carries out outgoing radiation of two or more light beams.

[Translation done.]

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TITLE: PROJECTION OPTICAL DEVICE

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APPL-NO: JP08168524

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ABSTRACT:

PROBLEM TO BE SOLVED: To prevent a device from being rotated without adding pressure to an electrical circuit board by connecting a connector and a cable.

SOLUTION: A virtual line L being in parallel with an arrow A is formed through the center C of the connector 29 on the electrical circuit board 26. Besides, the position of the connector 29 on the substrate 26 is decided so that the product of a distance (r) between the line L and the fitting center of a semiconductor laser light source 25 on the substrate 26 and force F added to the connector 29 when a harness 30 is attached and detached becomes equal to or under a prescribed value. Then, the harness 30 is connected to the connector 29 in a horizontal direction shown by the arrow A.